MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

TMA1401 – MATHEMATICS FOR INFORMATION SYSTEMS I

(All sections / Groups)

4 MARCH 2020
2.30 PM - 4.30 PM
(2 Hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 5 printed pages (inclusive of the front page) with 4 questions only. Page 5 is the appendix for the logical equivalence laws.
2. Attempt **ALL FOUR** questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.
4. Show **ALL** of your working steps clearly.

QUESTION 1 [TOTAL: 10 MARKS]

a) Let the universal set $U = \{x \in Z^{+} | 1 \leq x \leq 12\}$, set $A = \{2,3,6,7,9,12\}$ and set $B = \{x | x \text{ is an odd positive integer less than } 10\}$.

i) List all the elements of B. [1 mark]

ii) Find $A \cap B$. [1 mark]

iii) Find $(A \cup B) - (A \cap B)$. [1 mark]

iv) Draw sets U, A and B using a Venn diagram. Place the elements of the sets in correct regions and shade the region(s) that belong to $(A \cup B) - (A \cap B)$. [2 marks]

b) Suppose $S = \{(a,a),(a,b),(b,a),(b,c),(c,a),(c,b),(c,c),(d,d)\}$ is a relation on the set $A = \{a,b,c,d\}$.

i) Is S reflexive? Justify your answer. [1 mark]

ii) Is S symmetric? Justify your answer. [1 mark]

iii) Is S transitive? Justify your answer. [1 mark]

c) Let $f(x)=|2x|+3$ be the function from $\{x \in Z | -2 \leq x \leq 2\}$ to $\{x \in Z\}$.

i) Is f one-to-one? Justify your answer. [1 mark]

ii) Is f onto? Justify your answer. [1 mark]

QUESTION 2 [TOTAL: 10 MARKS]

a) Suppose that a vector $\boldsymbol{a}$ in the xy-plane has a length of 10 units and points in a direction that is 150° counter clockwise from the positive x-axis, and a vector $\boldsymbol{b}$ in that plane has a length of 5 units and points in the positive y-direction. Find the dot product $\boldsymbol{a} \cdot \boldsymbol{b}$. [1.5 marks]

b) Suppose that a line passing through point $A = (-2,9,3)$ and parallel to vector $\boldsymbol{a} = \boldsymbol{i} - 3\boldsymbol{j} + 4\boldsymbol{k}$.

i) Find the parametric equations for the line. [1.5 marks]

ii) Find the coordinates of the intersection point of the line and the xz-plane. [2 marks]

c) Consider matrix $\boldsymbol{A} = \begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$.

i) Show that $\lambda = -1$ is one of the eigenvalues for matrix **A**. [2 marks]

ii) Find the eigenvector for the matrix **A** corresponding to the eigenvalue $\lambda = -1$. [3 marks]

Continued ...

QUESTION 3 [TOTAL: 10 MARKS]

a) Construct a truth table to determine whether the compound proposition $r \rightarrow p \vee (\neg p \wedge q)$ is a tautology, contradiction or contingency. [4.5 marks]

b) Use the mathematical induction to show the following statement is true for all integers $n \geq 1$:

$$1 + 6 + 11 + \ldots + (5n - 4) = \frac{n}{2}(5n - 3).$$ [4.5 marks]

c) Given the recursion: $a_0 = 1$, $a_1 = 4$ and $a_n = 2a_{n-1} - a_{n-2}$ for integers $n \geq 2$. Find a_3. [1 mark]

QUESTION 4 [TOTAL: 10 MARKS]

a) *Figure 1* illustrates how 5 cities (*A*, *B*, *C*, *D*, and *E*) are linked by roads. For each case below, would you find an Euler circuit or a Hamilton Circuit as a solution? State an example of the circuit for each case.

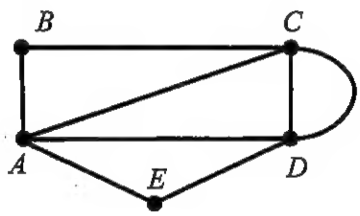

Figure 1

i) *Case 1*: A staff from department of public work must inspects all the roads to remove dangerous debris. The inspection must start and end with a same city. [1 mark]

ii) *Case 2*: A volunteer team is to supply relief food to emergency shelters located at each city. The trip for the food supply must start and end with a same city. [1 mark]

Continued ...

QUESTION 4 (continued)

b) Use the **breath first search algorithm** to find a spanning tree of the graph in *Figure 2*. Assume vertex B is the root and the vertices are ordered alphabetically. Show clearly each step of how the algorithm is performed.

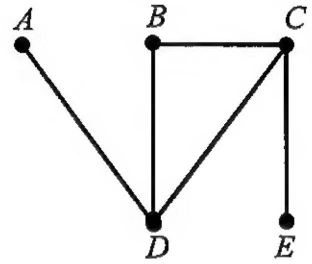

Figure 2 [5 marks]

[Important: For Question 4c, you must show proper steps on how to compute the answers.]

c) Suppose that an IT club consists of 9 students majoring in Data Sciences and 11 students majoring in Information Systems. The club is to form a team of 6 students to participate in an e-sport tournament.

i) How many ways are there to form the team? [1 mark]

ii) How many ways are there to form the team if it must have at least 5 students majoring in Information Systems? [2 marks]

Continued ...

Appendix

List of Logical Equivalence Laws

Conversion of Implication: $p \rightarrow q \Leftrightarrow \neg p \vee q$

Conversion of Equivalence: $p \leftrightarrow q \Leftrightarrow (p \rightarrow q) \wedge (q \rightarrow p)$

Double Negation: $\neg\neg p \Leftrightarrow p$

DeMorgan :	(i)	$\neg (p \wedge q) \Leftrightarrow (\neg p \vee \neg q)$		
	(ii)	$\neg (p \vee q) \Leftrightarrow (\neg p \wedge \neg q)$		
Domination :	(i)	$p \wedge F \Leftrightarrow F$	(ii)	$p \vee T \Leftrightarrow T$
Negation :	(i)	$p \wedge \neg p \Leftrightarrow F$	(ii)	$p \vee \neg p \Leftrightarrow T$
Identity :	(i)	$p \wedge T \Leftrightarrow p$	(ii)	$p \vee F \Leftrightarrow p$
Commutative :	(i)	$p \wedge q \Leftrightarrow q \wedge p$	(ii)	$p \vee q \Leftrightarrow q \vee p$
Idempotent :	(i)	$p \vee p \Leftrightarrow p$	(ii)	$p \wedge p \Leftrightarrow p$
Distributive :	(i)	$p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$		
	(ii)	$p \vee (q \wedge r) \Leftrightarrow (p \vee q) \wedge (p \vee r)$		
Associative :	(i)	$p \vee (q \vee r) \Leftrightarrow (p \vee q) \vee r \Leftrightarrow p \vee q \vee r$		
	(ii)	$p \wedge (q \wedge r) \Leftrightarrow (p \wedge q) \wedge r \Leftrightarrow p \wedge q \wedge r$		
Absorption :	(i)	$p \vee (p \wedge q) \Leftrightarrow p$		
	(ii)	$p \wedge (p \vee q) \Leftrightarrow p$		

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